

## The effect of working time in cold conditions on pain and fibromyalgia syndrome symptoms

Working in cold and its effects on pain

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### Abstract

**Aim:** This study aimed to investigate the effect of working time on cold and fibromyalgia syndrome symptoms. **Material and Methods:** The study included 568 individuals with a mean age of 36.9 years. Visual analog scale (VAS), The Revised Fibromyalgia Impact Questionnaire (FIQR) and 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria were used for evaluation. The groups were formed as 2 years or less, 3-5 years, 6-9 years and 10 years or more. For daily working hours, two groups created as less than 8 hours and 8 hours or more. **Results:** It was found that the score for VAS pain felt when working was higher compared to pain felt when resting ( $p=0.046$ ). FIQR scores increased significantly in the cold work year ( $p=0.006$ ) but there was no significant change in resting or working pain as working years increase ( $p>0.05$ ). FIQR total score, resting and working pain VAS values were found to increase for the group work more than 8 hours daily ( $p<0.05$ ). **Discussion:** As a conclusion, the results of this study showed that increasing working years and daily working hours caused an increase in the severity of FM related symptoms. Especially those who have been working for 10 years or more and/or more than 8 hours in cold were feeling greater pain and their fibromyalgia related symptoms were worse.

### Keywords

Fibromyalgia; Musculoskeletal Pain

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## Introduction

Occupational exposure to cold is a risk factor that can lead to a variety of health problems, cold-related diseases, and symptoms and also increases workload [1, 2]. The food processing industries must comply with strict standards regarding the temperature of the storage facilities. This may contradict the health conditions of workers. Cardiovascular, lung, peripheral circulation, skin, and musculoskeletal symptoms, complaints and diseases are common problems in these industries [3-5]. Besides, exposure to cold can lead to cooling injuries such as local cold bites, and hypothermia [6-8]. Cold exposure may cause various chronic diseases or may lead to worsening of existing diseases [4]. Epidemiological studies have shown that cold can be a risk factor for the exacerbation of disorders in various body areas [9-12].

Many tasks in the food processing industries are performed at low temperatures below 15°C. Fresh food is processed at temperatures ranging from -10°C to 6°C and frozen food is usually stored at -25°C. The cold conditions in the indoor environment are more predictable than the open-air environment, and generally, the temperature is constant throughout the year without any change depending on time. Moreover, contact with cold surfaces or cold materials is a risk for workers [13-15].

FM is a rheumatic disease because it causes pain in the joints and connective tissue. It has been reported that people with FM are often affected by other rheumatic diseases (e.g. rheumatoid arthritis, systemic lupus erythematosus, and ankylosing spondylitis) [16,17]. To date, the cause of FM has remained unknown. There is general evidence that traumatic events, obesity, and genetic predisposition will increase the likelihood of FM diagnosis in a person [18]. Lapossy et al. [19] reported that cold-induced vasospasm was greater in FM patients (38%) than in patients with low back pain (20%) and healthy controls (8%), indicating that the effect of cold on individuals under different conditions could change.

Protecting the health of working individuals, revealing the occupational risks and preventing these health problems are gaining importance both socially and economically. This study aimed to investigate the effects of working time in cold on pain and fibromyalgia syndrome symptoms.

## Material and Methods

This study was approved by the Clinical Research Ethics Committee at Abant İzzet Baysal University (No. 121 dated 26/05/2017, Decision No: 2017/37). The study was carried out according to the Declaration of Helsinki. All procedures were performed after written informed consent was obtained from all participants.

### Design

This is a descriptive study with subgroup analysis. The groups were formed less than 8 hours, 8 hours or more for daily working hours. For working years individuals grouped as ≤2 years, 3-5 years, 6-9 years and ≥10 years.

### Population

This study included individuals who were involved in cutting, shredding, packing, bagging and transportation operations at a poultry factory at an ambient temperature of 9°C and lower.

The assessments were done at the factory where the individuals worked. Inclusion criteria were as follows: working in a cold environment at least 9 degrees below the factory, not to have cooperative and mental problems, to be between the ages of 18-60 and to be a volunteer. The exclusion criteria were as follows: to have undergone surgery due to an orthopedic disorder, a history of trauma in the musculoskeletal system that still affects the person, and receiving physical therapy treatment.

### Variables

The demographic information form, 2016 Revisions to the 2010/2011 Fibromyalgia Criteria, The Revised Fibromyalgia Effect Questionnaire (FIQR) were applied to the individuals included in the study. Demographic information form was used to determine the characteristics of the participants in terms of gender, age, the years of current work, working hours per week, how many hours a day in the cold environment, height, body weight, dominant extremity, and presence of chronic disease. The level of pain felt during resting and working was questioned with VAS.

### Measures

#### Demographic Variables

A questionnaire was used to collect information about gender, date of birth, daily working hours in cold, working days in a week, body weight and height, dominant extremity, presence of chronic disease, use of painkillers, the level of pain felt while resting and working.

#### Fibromyalgia diagnosis

The 2016 revision of ACR 2010-2011 fibromyalgia diagnostic criteria consists of 2 stages. In the first section, the widespread pain index (WPI), the regions where the individual feels pain during the last week are identified from the 12 regions indicated in the questionnaire. Chin, shoulder girdles, upper arms, forearms, hips, thighs, legs, neck, back, waist, chest, and abdomen are inquired. Each box marked is worth 1 point. The final score is between 0-19 for WPI. In the second section, symptom severity scale (SSS), fatigue, waking unrefreshed, cognitive symptoms, headache, abdominal pain or cramps, depression are questioned. The final score is between 0-12 for SSS. If symptoms have been generally present for at least 3 months and  $WPI \geq 7$  and  $SSS \geq 5$ , or  $WPI$  4-6 and  $SSS \geq 9$ , meets the criteria for FM diagnosis [20].

#### Fibromyalgia Symptoms

The Revised Fibromyalgia Impact Questionnaire consists of 3 stages. The first stage inquires about daily activities. The second stage inquires about symptoms of FM and its effects. The third stage inquires about the level of sensitivity of the participant to pain, energy, sleep pattern, depression, memory problems, anxiety and fear, pain-pain sensitivity, mental balance problems and high sounds and bright lights are questioned. There are 11 boxes to choose from for each question. Leftmost boxes represent 0 and rightmost boxes represent 11 as severity. High scores indicate severe symptoms [21].

#### Pain severity

The VAS had a 10 cm horizontal line defining the minimum and maximum ends of the pain felt. Zero (0) "no pain" and ten (10) "irresistible pain" terms used as explanation at minimum and maximum ends, respectively.

**Table 1.** Distribution of gender, dominant extremity and smoking status by working year groups

		≤2 years (n=211)	3-5 years (n=140)	6-9 years (n=147)	≥10 years (n=70)	Total	χ <sup>2</sup>	p
		n	n	n	n			
Sex	Female	123	77	89	33	319	1,112	0,376
	Male	88	63	61	37	249		
Dominant extremity	Right	192	129	129	62	512	1,940	0,585
	Left	19	11	18	8	56		
Smoking status	Yes	88	56	52	28	224	1,499	0,683
	No	123	84	95	42	344		

χ<sup>2</sup>: chi-square test, , n: number of individuals, p>0,05

**Table 2.** Analysis of the FIQR, VAS resting and VAS working scores of the individuals according to working years and post-hoc evaluations of the FIQR scores by years of working

Individuals (n=568)	≤2 years (n=211)			3-5 years (n=140)			6-9 years (n=147)			≥10 years (n=70)			p1	Group comparison	p2
	X±SD	Med	IQR	X±SD	Med	IQR	X±SD	Med	IQR	X±SD	Med	IQR			
FIQR	23,85±20,05	18.66	30,67	23,85±22,41	19,91	26,21	28,75±22,41	24,83	29,17	33,47±21,05	27,41	31,58	0,006	<2 & 3-5	1,000
														<2 & 6-9	0,243
														<2 & > 10	0,011
														3-5 & 6-9	0,540
														3-5 & > 10	0,032
														6-9 & >10	0,909
VAS resting	2,72±2,98	2,10	4,80	3,04±2,97	2,10	5,00	3,29±3,27	2,20	6,50	3,77±3,26	3,90	6,85	0,064		
VAS working	2,91±3,22	2,10	5,10	3,38±3,28	2,85	5,10	3,54±3,43	2,70	6,10	3,78±3,16	3,75	6,03	0,107		

Kruskal -Wallis Test, X: mean value, SD: standart deviation, Med (%95 C), IQR: Interquartile range, p<0,05, p1: Kruskal- Wallis Test, p2: Kruskal- Wallis Post hoc Dunn

**Table 3.** Analysis of FIQR, VAS resting and VAS working scores of individuals according to the duration of the daily working hours in cold environment

Individuals (n=568)	<8 hours (n=174)			≥8 hours (n=394)			U	P
	X±SD	Med	IQR	X±SD	Med	IQR		
FIQR	21,34±18,65	18,33	22,21	28,50±21,69	25,00	31,67	42.618	0,00
VAS resting	2,20±2,76	1,00	3,93	2,20±2,76	3,10	5,85	41.013,5	0,00
VAS working	2,36±2,91	1,00	4,23	2,36±2,91	3,25	6,10	24.390,5	0,00

Mann-Whitney U test, X: mean value, SD: standart deviation, Med (%95 C), IQR: Interquartile range, U: Mann-Whitney U value, p<0,05

**Data Analysis**

Descriptive statistical methods used for demographic information. The chi-square test was used to determine the normal distribution of gender, dominant extremity and smoking status. The Wilcoxon test was used to compare the pain levels felt during resting and working. Comparison of VAS resting, VAS working and FIQR scores were performed by the Kruskal- Wallis Test. The Kruskal-Wallis Post hoc Dunn test was used to show the difference between working years groups. The Mann-Whitney U test was used in the analysis of daily working hours, VAS resting, VAS working and FIQR scores. The statistical significance level was taken as p <0.05 in the analysis of the data. SPSS 22 program was used for analysis. Groups were formed as ≤2 years, 3-5 years, 6-9 years, ≥10 years. To determine the

number of individuals required during the planning phase of the study, a study conducted with healthy workers was selected as an example [22]. The minimum number of individuals required was calculated to be 80% using the G \* Power program and found to be 368.

**Results**

Five hundred sixty-eight individuals were enrolled in this study. Individuals' ages ranged between 18-65 years and the mean age was 36,9 years. Individuals' weight ranged between 42-130 kgs and the mean weight was 71,4 kgs. Individuals' height ranged between 140-199 cms and the mean height was 165,3 cms. Individuals' BMI ranged between 16,7-41,9 kg/m2 and the mean BMI was 26,1 kg/m2.

Three hundred nineteen of the individuals were female (56.1%)

and 249 were male (43.9%). The dominant side of the individuals was in 512 (90.3%) right and 56 (9.7%) in the left. Gender and dominant extremities of the individuals according to study year groups are presented below (Table 1).

According to the results of the ACR criteria, the mean pain index scores were found to be  $3.42 \pm 3.50$  and the mean score of symptom severity was  $6.73 \pm 2.18$ . 92 individuals meet the criteria for diagnosis. Sixty-two of these individuals were female and 30 were male. Thirty-five, 20, 22, and 25 individuals meet the criteria for working year groups; 2 years or less, 3-5 years, 6-9 years and 10 years or more, respectively. There was no statistical difference between the working year groups in terms of diagnosis of fibromyalgia.

Pain felt during working, the pain felt during resting and the FIQR scores were examined for working year groups. Only FIQR scores were found to be significantly increased as the working years increase ( $p = 0.006$ ). When the post hoc evaluations of the analysis of FIQR scores of the individuals according to the years of study were examined, statistically difference was observed in FM symptom scores of the employees with more than a decade of study, less than two years and two to five years ( $p = 0.005$ ,  $p = 0.01$  respectively) (Table 2).

Three hundred ninety-three (69.1%) individuals worked more than 8 hours daily and 174 (30.9%) individuals worked in less than 8 hours in a cold environment. It was observed that VAS scores for resting and working pain and FIQR scores were significantly higher for the group worked more than 8 hours in a cold environment. (Table 3).

When VAS scores for resting (3,07) and working (3,3) pain levels were compared, the pain levels felt in working were significantly higher ( $p < 0.046$ ).

## Discussion

The results of this study showed that in cold conditions the workers felt pain while working and relaxing. It was found that the pain felt while working was higher. It was revealed that the pain felt during the rest and working in individuals working more than 8 hours a day was higher. Increased work years and more than 8 hours of daily study have been shown to increase the severity of FM symptoms.

It was shown in this study that increasing working years and daily working hours caused an increase in the severity of FM symptoms. This may be responsible for the negative effects of cold on pain and muscle function, cumulative fatigue caused by repetitive movements and microtrauma, and/or diseases such as FM, which can lead to changes in the perception of pain. Stevens et al. [23] examined the response of FM patients to cold pressor test by electroencephalography (EEG). According to the results of their study, the individuals with FM were less likely to feel the pain sooner than the control group, even if the EEG measurement for the pain was the same, and it was earlier that they defined the pain as intolerable. This indicates that FM patients treat painful warnings abnormally. Giannoccaro et al. [24], in their study of small fiber neuropathy in individuals with FM, in 30% of diagnosed individuals have determined the density of decreased epidermal nerve fiber. Abnormalities of adrenergic and cholinergic nerve fibers of these individuals were also observed. This suggests that FM is a condition that may have an impact on sensory and autonomic symptoms [24].

Nørregaard et al. [25] found a decrease in voluntary muscle strength of the elbow flexors and extensors by 20-30% in FM patients. We think that FM can affect the quality of life negatively in individuals working in a cold environment and increase the sensibility of non-FM pain, especially since the effects of FM on the musculoskeletal and nervous system can be related to cold. McDonald et al. [26], reported that arthritis, back, and FM pain were mostly clinically significant, and were associated with significantly lower levels of health-related quality of life. They stated that the presence of pain was associated with higher levels of work efficiency loss.

In this study, it has been concluded that the complaints about FM have reached peak value in cold environment employees in a period of 10 years and more, although no association with FM diagnosis was detected. This raises the question of whether severe FM symptoms are caused by other diseases. Musculoskeletal problems and carpal tunnel syndrome are the usual suspects that may cause similar symptoms with FM. Fatigue, weakness, or not being able to perform normal tasks or difficulties can be associated with these diseases. Waylonis et al. [27] reported that FM activities were reported to aggravate FM symptoms; computer use or writing (37%), prolonged sitting (37%), prolonged standing and walking (27%), stress (21%), heavy lifting (19%) and repeated movement and load-carrying (18%) were reported. These activities aggravated the symptoms of the individuals participating in this study; long periods of standing, heavy lifting, repetitive movements and transporting goods. Lapossy et al. [20] reported that cold-induced vasospasm was more common in FM patients (38%) than in healthy controls (8%); this suggests that the cold effect may cause negative effects in the musculoskeletal system of individuals with FM. Exacerbation of FM symptoms due to increased working years and daily working hours is a factor that can reduce work efficiency. It is concluded that this factor is a problem that can lead to a loss of workforce in the occupations that increase the risk of FM.

It was found that the pain felt while working was higher than at rest. Individuals who worked for 8 hours and over had significantly higher levels of pain felt in working and at rest. It has been shown that the prevalence of pain increases as the working hours spent on repetitive strenuous physical activities increase [28]. Exposure to occupational cold has been identified as a risk factor that can lead to various health outcomes, including increased workload and symptoms such as cold-related diseases and pain [1,3,4].

## Conclusion

As a result of this study, some risks of working in a cold environment have been revealed. Especially those who have been working for 10 years or more and more than 8 hours in cold were found to be under greater risk. To reduce this risk, it may be advisable to reduce daily or weekly working hours or scheduling more breaks. The use of protective clothing can be encouraged to reduce the effect of cold. To reduce long-term physical activity and continuous work in the same posture, doing different works with rotation may reduce the symptoms. The use and regular maintenance of auxiliary equipment to reduce the workload may benefit employee health. The use of robotic systems and automation can reduce the number of employees at risk.

**Scientific Responsibility Statement**

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

**Animal and human rights statement**

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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**Conflict of interest**

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